

Docket No.: ARL-02-27
(PATENT)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of:
T. Richard Jow et al.

Application No.: 10/625,686

Confirmation No.: 9428

Filed: July 24, 2003

Art Unit: 1745

For: ADDITIVE FOR ENHANCING THE
PERFORMANCE OF ELECTROCHEMICAL
CELLS

Examiner: Gregg Cantelmo

DECLARATION OF T. RICHARD JOW SUBMITTED UNDER 37 CFR 1.132

I, T. Richard Jow, hereby declare as follows:

1. I am currently a Research Physical Scientist/Team Leader and have over 16 years of lithium and lithium-ion battery research experience at ARL.

2. I earned a Ph.D. degree in Materials Science and Engineering from Northwestern University in 1977. From 1977 to 1978, I held a post-doctoral position in Materials Science at Northwestern University. From 1978 to 1982, I was a Senior Scientist at Electrochem Industries (a subsidiary of Wilson Greatbatch Limited) developing lithium batteries based on solid-state and nonaqueous liquid electrolytes. From 1982 to 1988, I was a Senior Chemist at Allied-Signal developing rechargeable lithium battery based on conducting polymer/alkali metal composite anode and lithium inserted metal oxide cathode.

3. I am a co-inventor of the above-identified patent application, U.S. Patent Application Serial No. 10/625,686 ("the Application") and I have read the Office Action dated March 27, 2006 (the "Office Action"). I have also reviewed and am familiar with U.S. Patent No. 6,783,896 (Tsujioka et al.) and U.S. Patent No. 6,506,516 (Wietelmann et al.).

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4. I understand that claims 1-4, 6-8 and 13 of the Application have been rejected as being obvious over Tsujikata et al. in view of Wietelmann et al. on the basis that the combination of lithium bis(oxalato) borate and lithium oxalyldifluoroborate is considered to provide no real advantage over either additive salt included by itself. I state that in fact the combination of the two additive salts shows improved rate capability and low temperature performance compared to a cell containing only lithium bis(oxalato) borate with nearly the same rate capability and low temperature performance as a pure oxalyldifluoroborate cell yet offering better utilization electrode materials.

5. To demonstrate the basis for my statement that the combined additive salt provides better results than either salt alone, an experiment was conducted as to effect of salt ratio on the cycling performance of Li-ion cell with a $1.0 \text{ m } x\text{LiODFB}-(1-x)\text{LiBOB PC-EC-EMC}$ (1:1:3) electrolyte. Li-ion cells with the same configuration as described in Example 11 were assembled but using $1.0 \text{ m } x\text{LiODFB}-(1-x)\text{LiBOB PC-EC-EMC}$ (1:1:3) electrolyte (electrode area of the cells: 0.97 cm^2). Due to the limited solubility of LiBOB in electrolytic solvent, a concentration of 0.8 m was used in the case of $x=0$. The cells were initially cycled for 2 cycles at a current density of 0.1 mA/cm^2 between 2.5 and 4.2 V as the pre-conditioning, followed by cycling at 0.5 mA.cm^2 between 2.5 and 4.1 V for additional 10 cycles. Table 8 shows the reversible capacities of these cells at 0.1 and 0.5 mA/cm^2 , respectively. It is indicated that the cells with single salt electrolyte (i.e., $x=1$ and 0 , respectively) have lower capacity than those using the mixed salt electrolyte. This fact indicates that mixing LiODFB and LiBOB assists in increasing the utilization of the electrode materials.

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Table 8: The effect of salt ratio on the discharging capacity ($\text{mA}\text{h}/\text{cm}^2$) of Li-ion cells

	x=1	x=0.5	x=0.2	x=0
0.1 mA/cm^2 , 4.2 V	1.25	1.36	1.35	1.23
0.5 mA/cm^2 , 4.1 V	1.06	1.16	1.12	1.06

Note: Salt concentration was 0.8 m for x=0 due to the limited solubility of LiBOB.

The attached Figs. A and B show the impact of salt ratio in 1.0 m $x\text{LiODFB-(1-x)LiBOB}$ PC-EC-EMC (1:1:3) electrolytes on the rate capability and low temperature performance of these Li-ion cells. Fig. A shows the effect of salt ratio on the rate capability of graphite/cathode Li-ion cells using 1.0 m $x\text{LiODFB-(1-x)LiBOB}$ PC-EC-EMC (1:1:3) electrolytes with different x values. Fig. B shows the effect of salt ratio on the low temperature performance of graphite/cathode Li-ion cells using 1.0 m $x\text{LiODFB-(1-x)LiBOB}$ PC-EC-EMC (1:1:3) electrolytes with different x values. It is indicated that the cell with x=0.5 remains nearly the same rate capability and low temperature performance as the single LiODFB (x=1) cell does, while providing better utilization of the electrode materials (see Table 8). When x=0.2, the cell shows much improved rate capability and low temperature performance as compared with the single LiBOB cell (x=0), however, is inferior to the single LiODFB cell (x=1). The results above indicate that the optimized improvement can be achieved by the addition of appropriate amount of LiBOB into LiODFB.

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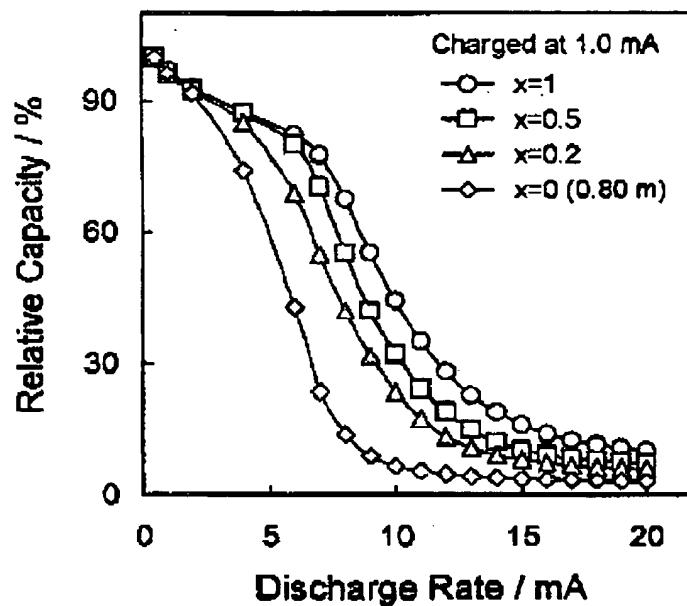


Fig. A

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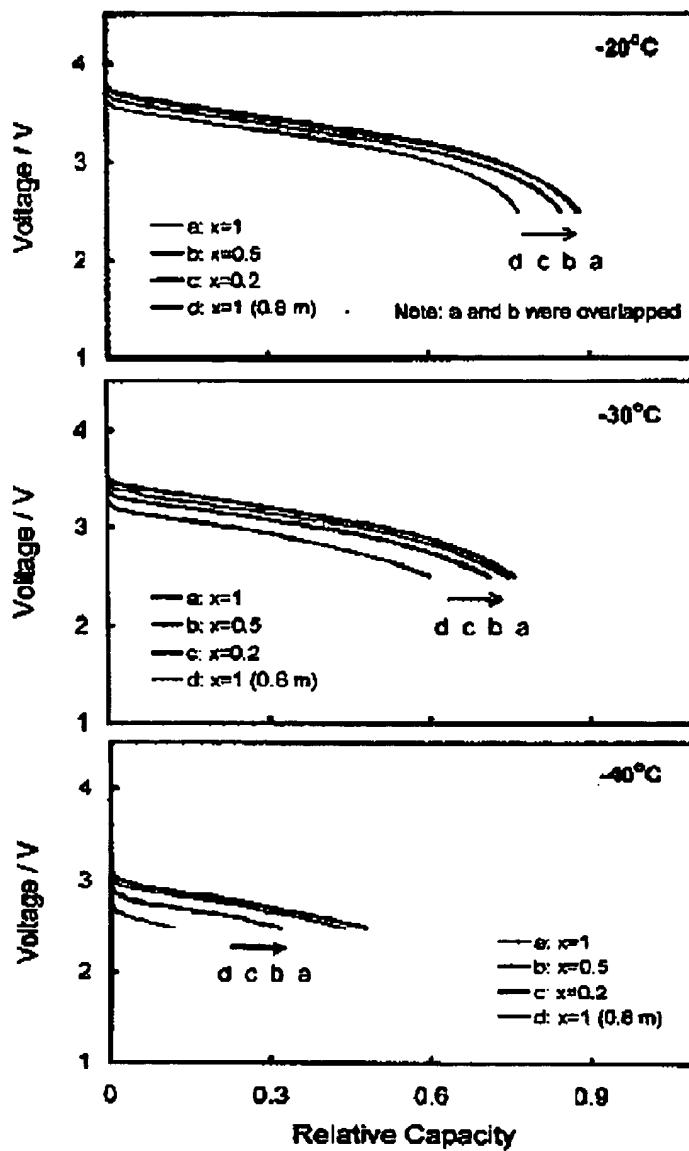


Fig. B

6. I believe this data to show with certainty that the addition of appropriate amount (<50% in mol) of LiBOB into LiODFB electrolytes favors increasing the utilization of electrode

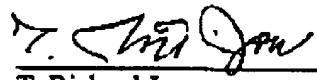
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active materials while still remaining excellent rate capability and low temperature performance of LiODFB salt. As a result, I believe the Examiner's concerns about the criticality of the combination have been addressed and that neither Tsujioka et al. nor Wietelmann et al. provides any indication that one might expect the results I have detailed above that are reflected in the pending claims.

7. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true. These statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.



T. Richard Jow

Date: August 24, 2006

ANG/gs